CLAIM + DETAILED DESCRIPTION

[Claim(s)]

Stamp structure characterized by comprising the following for 1. lithography processes.
A layer which consists of the 1st material for performing ** form contact with the surface of a substrate (30; 40; 60), and the surface of said stamp structure and which can be transformed (14; 24).
A patternizing layer which consists of the 2nd material provided with a lithography pattern which should be transferred to said substrate (12; 22).

2. Stamp structure according to claim 1 including further rigid support (16; 26) for preventing unnecessary modification of said layer which can be transformed when load is added.
3. It is characterized by including further an automatic position **** means (301, 311; 401, 411, 420) for exact relative positioning or modification of said substrate (30; 40) in a lithography process, and said stamp structure (31; 41), or its both. The stamp structure according to claim 1.
The stamp structure comprising according to claim 3:
4. Said automatic position **** means is a projection element (311).
A dent element (301) which corresponds besides it had an inclination side wall preferably.

5. Stamp structure according to claim 3, wherein said automatic position **** means includes surface tension inclination.
6. Stamp structure according to claim 5, wherein compatibility [as opposed to a fluid in surface tension inclination] is attained with pad (401, 411) higher than the adjacent spaces.
7. Directions of stamp structure according to claim 1 for lithography of less than micron.
A lithography process of being characterized by comprising the following.
8. Layer which consists of the 1st material for performing ** form contact with the surface of

substrate (30; 40; 60), and the surface of stamp structure and which can be transformed (14; 24; 714).
A step which adjusts stamp structure containing a patternizing layer (12; 22; 712) which consists of the 2nd material provided with a lithography pattern which should be transferred to said substrate.
A step which applies a substance (719) to said patternizing layer.
A step which **-form-contacts said patternizing layer on said surface of said substrate.

9. A step which prepares a master position **** stamp (60) provided with a position **** mark (611), The lithography process according to claim 8 that it is characterized by including further a step which uses said position **** master in order to reproduce an automatic position **** means (602; 718) on a substrate and a patternizing layer in a correctly corresponding position.

[Detailed Description of the Invention]
Stamp for lithography processes Generally this invention relates to a lithography process. More specifically, this invention relates to the elastic stamp for using it in such a lithography process.
The background of an invention Optical lithography is very important for the mass production since the appearance of an integrated circuit (IC) and a micro mechanical apparatus. That is, the huge market is made by the facilities, parallel operation, and resolution. In manufacture of the remarkable small device of a size required in order to fill the demand of the increasing storage and consumption, if a process approaches steadily the basic limit mainly set up by diffraction, visible light will become a problem increasingly. Such recognition became a cause and the eager research in UV, X-rays, an electron beam, and scanning probe (SP) lithography started. Although such a method brings about high resolution, the degree of success is various, and even if it often sees the economical efficiency, it is still uncertain. There are difficulty at the time of looking for the lateness of a write-in speed of restriction by a wavelength dependence phenomenon, an electron beam, and SP lithography and a suitable resist as a Reason of such uncertainty, etc.
The separate restriction to which the present lithography relates is the complexity of a process required for pattern transfer.
The present lithography uses transferring material from the liquid phase or the gaseous phase using a mask, in order to protect the given field of a substrate so that the degree of restoration of a device may assemble and it may become higher.

The alternative technique about lithography is released to Appl.Phys.Lett.63 (14) by A.Kumar

and G.M.Whitesides, October 4, 1993, and 2002-2004 pages. In this process called stamp lithography, a stamp is manufactured by casting poly (dimethylsiloxane) (PDMS) on a master by the negative of a desired pattern. A PDMS stamp exfoliates from a master after hardening, and is exposed to the "ink" transferred by the substrate by transitional contact with a stamp. With the elastic characteristic of PDMS, contact becomes possible also on the coarse surface or the curved surface. By this method, the feature of the range of 1-100 microns is carried out. When a stamp and a feature are larger than this (1 cm - 200 microns), in order to dissolve the field exposed to UV light a priori, a pattern is directly etched into a stamp by the conventional UV lithography which uses a weak soap solution. When applying this method to the lithography provided with the feature of less than a micron, in the stamp of the type which Kumar etc. spread, it turns out that a result with reproducibility required for mass production of IC is not obtained at all. The main limits of this pattern transfer method are elastomers used as a base material of a pattern. Since this material can change, in high resolution required for practical lithography, a pattern is repeated to a substrate and it cannot be correctly transferred to it. Therefore, it is considered that it is glance-like [this invention] to improve the method by Kumar etc. so that stamp lithography can compete with the present newest lithography. It should be attained by the method of reproducing the 0.1-1-micron-wide feature which was specifically suitable also in order to cover the conventional wafer size.

Outline of an invention The purpose of this invention is attained by the stamp indicated to Claim. This new compound stamp avoids restrictions of the stamp of a prior art. If a new stamp is used, it can attain by the method of reproducing the feature size or the "design rule" below 1 micron. According to the new structure, it can optimize so that it may consistent with all the important characteristics, i.e., rigidity, ** form contact, and exact pattern transfer simultaneously.

It is considered that it is one of the important features of this invention that a stamp contains the 2nd layer (patternizing) coping with change of the thickness of a substrate and the impurities on the surface that the modification for ** form contact was possible, or is tinged with an elastic layer and a desired pattern. As for this layer, it is preferred to be made from 10^4-10^7 and the material which has more preferably the Young's modulus of the range $0.25*10^6$-$5*10^6$DAIN/cm^2. As a material which has this characteristic, poly (butyl JIEN), poly (dimethylsiloxane), poly (acryl amide), poly (butyl styrene), and a such type copolymer can be considered. It is desirable to optimize the characteristic of an elastic layer so that the pliability of a desired quantity may be controlled.

There are some advantages which exceed a known uniform elastic stamp in the stamp by this invention. The material of both layers can be mutually optimized independently to a remarkable grade. Therefore, it is desirable to provide the patternizing layer which can write in the feature of less than a micron easily according to a lithography process. A specific "ink" material should

be pasted easily or this patternizing layer should absorb that material. Also after applying repeatedly in a lithography process, it is desirable to generate a patternizing layer from a desirable material which holds a pattern feature correctly and in which un-changing is possible. This patternizing layer has high Young's modulus, and can be made from the material which exceeds 10^6 DAIN / cm^2 preferably. As a suitable material, according to the desired characteristic and applicable field, organic insulators, such as poly (styrene) or poly (methyl methacrylate), Inorganic insulators, such as metallic insulators, such as gold, platinum, palladium, nickel, titanium, and its oxide, alumina, silicon, silica, and a perovskite, can be considered.

Less than 10 microns of elastic layers of the desirable embodiment of this invention are preferably attached on a rigid support structure within the limits of the permissible error of the range of 1 micron - 1 nm. The desirable support material is provided with the coefficient of thermal expansion near substrate material. As for this support, it is preferred to be chosen from the group which consists of a substrate or wafer materials, such as glass, silica glass, rigid plastic material, and silicon. When attaching on support structure, the elastic layer itself can be made thin. As for the thickness, it is preferred that it is within the limits of 10-1000 microns. In the range of this thickness, even if any modification can be absorbed by an elastic layer and pushes a stamp into a lithography process, the feature of a pattern maintains that size. If the automatic position **** means projected so that it might indicate below is used, the thickness of an elastic layer can be chosen as a desirable thing from the range of 10-10000 microns. It is clear that the above-mentioned support structure can apply in favor also of the known one-layer stamp by Kumar etc.

The stamp of other desirable embodiments includes the means for attaining automatic position ****. For example, a topology feature a key / lock type can be included by this means, and this is guided to the final position of a request of a stamp, after positioning in advance correctly enough by stepping drive. [, such as a cone, or a projection part, a hole of a pyramid form,] However, the desirable means for carrying out automatic position **** of a stamp and the substrate uses the surface tension inclination established on a stamp, a substrate, or the surface of the both. Such a slope is attained by arranging a pad on a substrate and the surface of a stamp, for example, and said pad is characterized by the changed surface which shows the height of the compatibility over fluids, such as oil or water.

The above considered to be peculiar to this invention and the other new features are indicated to Claim. However, the other purposes and advantages will be able to be best understood to be this invention itself and a desirable operating mode, if detailed explanation of the embodiment shown below is read in relation to an accompanying drawing.

Explanation of Drawings In relation to the following Drawings, this invention is explained in detail.

the -- the [A / 1 / figure thru/or] --E [1] figure is a figure showing the basic step of the 1st method for generating the stamp by this invention.
the -- the [A / 2 / figure thru/or] --D [2] figure is a figure showing the basic step of the 2nd method for generating the stamp by this invention.
Fig. 3 is a figure showing the key / lock type means for automatic position **** of a stamp and a substrate.
the -- the [A / 4 / figure and] --B [4] figure is a figure showing the means for automatic position **** of the stamp and substrate based on surface tension inclination.
Fig. 5 thru/or Fig. 7 are figures showing the basic step for preparing the stamp and substrate for stamp lithography.
Fig. 8 is a figure showing how to use the new stamp by this invention in a lithography process.
embodiment of the invention the -- the [A / 1 / figure thru/or] -- the 1st example of this invention is explained with reference toE [1] figure. Although this process begins from the silicon wafer 10, this wafer is presenting the very even surface. This surface is coated with the thin layer 11 of fault fluorination Silang. Fault fluorination Silang prevents the following layers from adhering or combining with the silicon surface. Next, the layer of a brittle material which can hold a pattern correctly is adhered on the layer 11. This brittle material is either of the polysilicon to which it adheres by the poly METAKURU acid methyl (PMMA) or chemical vapor deposition to which spin coating adheres. Both of the adhesion methods are well-known things in this technical field. The thickness of a layer is chosen according to the so-called "design point" of average feature size and about 1:1 ratio. This layer 12 is built by conventional UV lithography or electron beam lithography. The spacer element 13 is arranged on the wafer 10. Pre polymer of poly dimethylsiloxane (PDMS) is cast and the elastic layer 14 is formed on patternizing PMMA or the polysilicon 12 after a hardening process so that it may become the capacity specified with a spacer element. The 2nd silicon wafer 16 is taken down on a spacer element, and PDMS of a superfluous quantity is pressed out from the gap between spacer elements. This 2nd silicon wafer is pretreated in Silang which brings about the adhesives-like layer 15 and which makes OREFIN an end group, in order to combine with PDMS. By raising this assembly, the lower layer 10 of silicon is separated from the remaining portion. then -- generating PMMA or the patternizing layer of polysilicon by dissolving or etching an exposure region -- the [as a result,] -- the compound stamp structure shown inD [1] figure is acquired. Between the patternizing PMMA layer 12 and the layer 14 which can be transformed, the additional layer 17 can be introduced so that it may become the additional support of a pattern after the generation. the -- this intermediate layer is constituted from PMMA by the example shown inE [1] figure. However, this layer can be replaced in the layer of indium tin oxide (ITO) which is a conductive material.In addition to strengthening the stability (and conductivity) of a pattern, the layer of this addition prevents the charge of an elastic material of the layer 14 from

permeating from the opening of the patternizing layer 12.
the 2nd method for generating a compound stamp -- the -- the [A / 2 / figure thru/or] -- it is shown inD [2] figure. First, the master board 20 is formed with the conventional lithography method (or stamp lithography written in this Description). This master pattern is processed in fault fluorination Silang 21 as a separating medium. Then, spin coating of the layer 22 of PMMA is carried out on an assembly. Subsequent steps (the [C / 2 / figure,]D [2] figure) are equivalent to the step of a front example. By raising an assembly, a stamp and a master are separated and it leaves the master 20 for the duplicate of a subsequent stamp.
Next, reference of Fig. 3 shows the 1st automatic position **** means on the PMMA the substrate 30 and the stamp 31 containing the rust form projection part 311 which goes away which exceeds the feature of the lithography pattern 312 in the figure. The projection part 311 gets into the dent 301 of a corresponding substrate exactly. This can be attained by using the same position **** stamp, when denting to a substrate and the master by which a stamp is reproduced and generating 301. However, a substrate is made from the same material, if all the etching parameters are equal, it dents with the wedge 311 and 301 is correctly in agreement.
This concept of providing a coincidence mark on a substrate and a stamp is explained in full detail below.
Since precision adjustment with a stamp and a substrate is performed, the geometric shape, for example, the inclination side wall, of a feature, [a lock / key type automatic position ****] the -- the [A / 4 / figure and] -- as shown inB [4] figure, the following examples of the automatic position **** means are based on the characteristic or a tendency of the fluid which makes the surface the minimum. With regulation of the amount of moisture, a small drop is formed between the pads on these pads with the hydrophilic pads 401 and 411 on the substrate 40 and the surface of stamp 41 both, and an efficient automatic position **** mechanism is realized. To a substrate, when poor position **** of a stamp is small, the stability which returns to regular shape is acquired by the drop 420 inserted in between, and, thereby, a stamp moves to the position of the request by it. This drop is generable in the state where it adjusted, by exposing a pad to the humidified inactive gas (**** nitrogen). However, the feature of Fig. 4 should care about not being drawn by fixed scale like other Drawings of all the. The size of the drop must be about the 3rd power of the design rule mostly.
or the effect of this method adheres the hydrophobic zone 402 to the circumference of each pad 401 -- the [or] -- it can increase by arranging a pad on the pillar-shaped support 412, as shown inB [4] figure. the -- as shown also inB [4] figure, another advantageous characteristic of the drop 420 inserted in between is that it functions as an elastic cushion, when pressure is applied to an assembly. Therefore, shortly after releasing the pressure applied according to the drop 420 or the spring power of the pillar 412 which changed, a stamp is lifted from a

substrate.

An automatic position **** means is arranged near the line of dehiscence of a wafer, and it must be made, to have to occupy the minimum usable wear field as a result. Also in this case, the transverse direction size of an automatic position **** means becomes a design rule grade mostly.

Subsequent Drawings show the basic step for preparing the position **** finishing assembly which comprises a wafer board and one or more stamps.

As for the position, although the position **** master 50 shown in Fig. 5 is prepared in the 1st step, this is dented in the beforehand selected position, and is provided with 501, and it is preferred to be located in the designed field so that it may become a line of dehiscence of the wafer which should be manufactured. From this position **** master, two or more position **** stamps 61 are generable as a replica to which the position **** mark 611 was attached (theA [6] figure). In order to provide a hydrophilic pad on a wafer, the replica of a position **** stamp is combined with 16-MERUKAPUTO hexadecanol acid 612 or 16-MERUKAPUTO hexadecanol, This substance is transferred by stamp contact printing (theB [6] figure) on the wafer 60 covered with the film 601 of thin gold, and adheres to CHIORU. Next, the film of gold without a cover is removed and the CHIORU pad 602 is used as protection coating. After vapor-depositing the film of another gold, shielding the pad circumference with a mask, a wafer is prepared for succession processing (theC [6] figure).

the [next,] -- reference ofA [7] figure shows the silicon stamp master 70 covered in fault fluorination Silang 702 in the figure. In front of the lithography pattern 703, as shown in Fig. 5, the position **** stamp obtained from the position **** master is used, and the position **** dent 701 is marked on silicon, and is etched. The lithography pattern 703 is generated by the conventional electron beam lithography, and is written in using the coordinates over the position **** mark 701. The stamp provided with various lithography patterns can be manufactured by using the same position **** stamp to various stamp masters, and positioning a lithography pattern relatively to a position **** mark. Such a stamp can be transposed to the mask used with a known lithography method. Position **** of these stamps of each other is essentially carried out for the above-mentioned manufacture procedure. the -- the [A / 6 / figure thru/or] -- as mentioned above with reference toC [6] figure, all the stamps generated in this way can be arranged on a wafer by an automatic position **** method by using the same position **** stamp to a wafer.

a stamp master -- the -- spin coating of the patterned layer of the compound stamp 712 (PMMA) shown inB [7] figure is carried out. Before adhering the elastic layer 714 (PDMS), the resist within the dent 701 is exposed, and it is removed by etching, and is replaced in the layer 718 of thin gold (theC [7] figure). Next, the spacer element 713 is attached to a side part outside a stamp master, and the capacity which was carried out in this way and made is filled

up with the elastomer 714 (theD [7] figure). As mentioned above, it adheres considering the 2nd silicon plate 716 as supporters. After raising a stamp assembly and carrying out trimming of the rim (theE [7] figure), the stamp 71 is immersed in the solution of CHIORU 705 which makes carboxyl (COOH) an end group, and the hydrophilic pad 718 is made to adhere to the position **** projection part 711. Manufacture of the stamp 71 completes the layer 712 provided with the lithography pattern with the substance 719 which should be transferred to a wafer by carrying out humidity (the [7F figure,] 7G figure).

In the case of an actual lithography process, as shown in Fig. 8, moisture content gas is sprayed to the hydrophilic pad 601 on the surface of the wafer 60 prepared at the front step (theC [6] figure). The stamp 71 is positioned by a known position **** means so that the hydrophilic pad 718 may be mostly juxtaposed with the thing on a wafer. Next, final position **** is attained by the surface tension of the drop 820 inserted between hydrophilic pads.

By applying pressure to the stamp 71, a lithography pattern is transferred to the wafer 60 until the layer 712 which carried out humidity can touch the surface coat 601 of a wafer. Although the substances 719 may be a reaction thing, an etching solution, protection coating, etc., they are transferred by all the contact fields.

[Translation done.]